Math 499 Syllabus, Spring 2018

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Course Information: Meets on Fridays 12:00 - 12:50 in HBH 423. Office Hours are by appointment only.

Course Description & Aims

This class is an undergraduate research seminar intended to give you some hands-on experience of how modern mathematical research is done, specifically in the area of number theory. We will be studying **obstructions** to local-global principles in number theory this semester, particularly the question of when a quadratic form represents an integer locally but not globally. The course will begin with lectures on the basic objects we'll be studying, such as the p-adic numbers, quadratic reciprocity, quadratic forms, Hilbert symbols, and quaternion algebras. Once you have the necessary background, you will transition into working on a concrete project in this field. Although these topics can get quite deep and technical, only a basic knowledge of abstract algebra will be required. All of the definitions and theorems we will be using can be explained in an elementary way.

Assignments

Background reading with exercises will be assigned on a weekly basis. While these assignments will not be graded, you will be expected to take turns presenting on the material in class. There will be no exams, however we will periodically have written assignments to make sure you understand the material.

Expectations and Grading Policy

Your grade will be determined by active participation and attendance.

The primary objectives of this course are as follows:

1) Reading mathematics critically: How you do this will vary slightly depending on your particular learning style, but there are certain guidelines you should try to follow to start with. Ultimately, the goal is to become an active rather than a passive reader. For example, you will be expected to generate your own questions as you read. This can seem daunting at first, but once you learn the right process to follow, it will start to become natural. For some techniques and general advice, see the following articles:

- How to Read Mathematics:
  `http://web.stonehill.edu/compsci/history_math/math-read.htm`
- A Few Mathematical Skills: Reading Theorems and Reading Definitions:
  `http://www.maa.org/node/121566`

2) Starting your own research: Research mathematics often looks quite different from other (undergraduate) mathematics you might have seen up to this point. In particular, one might choose a project in which not only is the answer unknown, but even the path or tools involved in the process of finding the answer is unclear. Sometimes even the question itself isn't clear from the start! Number theoretic questions may sometimes be simple to state but surprisingly complicated to prove (e.g. Fermat's last theorem), but the field is rich with open problems! In this course, under the guidance of the instructors, students will explore and make observations, formulate conjectures, and attempt to prove these conjectures. Students should not get discouraged if a conjecture is false or if an idea for a proof does not succeed. Research takes time and patience, and each "wrong" idea gives new insight into a problem. You may want to read the following article for some techniques:

- One Introduction to Mathematical Research:
  `http://www.math.uiuc.edu/~reznick/mhoriz.pdf`

Attendance

Attendance is crucial for this class, as it only meets once per week and forms the basis for the majority of your grade. Please do not sign up for this course unless you are confident you will be able to attend class regularly.